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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/668,986	09/22/2003	Valery M. Dubin	10559/856001 / P17304/Int	1755

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EXAMINER	
IM, JUNGHWA M	
ART UNIT	**PAPER NUMBER**
2811	

DATE MAILED: 04/20/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	10/668,986	DUBIN ET AL.
	Examiner	Art Unit
	Junghwa M. Im	2811

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *06 February 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-4,6-11,13,14,32 and 33* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4,6-11,13,14,32 and 33* is/are rejected.

7)☒ Claim(s) *5 and 12* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 2 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sambucetti et al. (US 6335104), hereinafter Sambucetti in view of Lee et al. (USPub. 2005/0156315), hereinafter Lee.

Regarding claim 1, Fig. 2 of Sambucetti shows an apparatus, comprising:

a semiconductor substrate (a region below the element 12);

a first conducting layer (12) in contact with the semiconductor substrate, the first conducting layer comprising a base layer metal, the base layer metal comprising Cu (col. 5, line 61-64);

a diffusion barrier (16) in contact with the first conducting layer;

a wetting layer (18) on top of the diffusion barrier; and

a bump layer (40) on top of the wetting layer, the bump layer comprising Sn and wherein the diffusion barrier being formed configured to prevent Cu and Sn from diffusing through the diffusion barrier and to prevent CuSn intermetallic formation in the apparatus.

It is noted that it is obvious that the diffusion barrier layer of Sambucetti's device is configured to prevent Cu and Sn from diffusing through the diffusion barrier and to prevent CuSn intermetallic formation in the apparatus since the material for the diffusion barrier layer of

Sambucetti's device is identical to the one in the instant invention. Furthermore, it is known in the art that diffusion barrier layer is formed to prevent the intermatallic formation between the layers as disclosed by Sambucetti (col. 1, lines 39-41).

Fig. 2 of Sambucetti shows most aspect of the instant invention except "the diffusion barrier comprises a metal alloy comprising boron and phosphorous."

Lee discloses that the diffusion barrier comprises a metal alloy comprising boron and phosphorous (paragraph [0035]).

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teachings of Lee into the device of Sambucetti in order to have the diffusion barrier comprising a metal alloy comprising boron and phosphorous to accommodate desired specification.

Regarding claim 2, it is obvious that the diffusion barrier layer of Sambucetti's device is configured to suppress whisker-type formation in the bump layer since the material for the diffusion barrier layer of Sambucetti's device is identical to the one in the instant invention. Furthermore, Sambucetti discloses that the diffusion barrier is utilized to alleviate whisker-type formation (lift-off defect; col. 1, lines 39-50).

Regarding claim 7, Fig. 2 of Sambucetti shows the wetting layer comprises NiP, (col. 6, lines 29-30) wherein the diffusion barrier is further configured to reduce bump layer delamination (lift-off defect; col. 1, lines 39-50).

Claims 1, 3 and 8-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tong et al. (US 6827252), hereinafter Tong in view of Lee

Regarding claim 1, Fig. 7 of Tong shows an apparatus, comprising:

a semiconductor substrate (310);

a first conducting layer (316, 320) in contact with the semiconductor substrate, the first conducting layer comprising a base layer metal, the base layer metal comprising Cu (col. 6, line 4);

a diffusion barrier (330) in contact with the first conducting layer;

a wetting layer (340) on top of the diffusion barrier; and

a bump layer (350) on top of the wetting layer, the bump layer comprising Sn (col. 4, lines 55-59), the Sn bump a layer, the diffusion barrier being formed configured to prevent Cu and Sn from diffusing through the diffusion barrier and to prevent CuSn intermetallic formation in the apparatus (col. 6, lines 43-46).

Fig. 7 of Tong shows most aspect of the instant invention except "the diffusion barrier comprises a metal alloy comprising boron and phosphorous."

Lee discloses that the diffusion barrier comprises a metal alloy comprising boron and phosphorous (paragraph [0035]).

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teachings of Lee into the device of Tong order to have the diffusion barrier comprising a metal alloy comprising boron and phosphorous to accommodate desired specification.

Regarding claim 3, Fig. 14 of Tong shows a solder layer (380) positioned between the bump layer (370) and a die package, wherein the solder layer comprises Sn (col. 5, lines 4-7).

Regarding claim 8, Fig. 7 of Tong shows the apparatus further comprises an another base layer metal (320).

Regarding claims 9 and 13, Fig. 7 of Tong shows an apparatus, comprising:

a base layer metal (316, 320) on a semiconductor substrate (310), the base layer metal comprising Cu (col. 6, line 4);

a bump layer (350) on top of the base layer metal;

a diffusion barrier (330) in contact with the bump layer;

a wetting layer (340) on top of the diffusion barrier; and

a solder layer (380) contacting the bump layer, the solder layer comprising Sn (col. 5, lines 4-7), the diffusion barrier being further configured to prevent the diffusion of Cu and Sn through the diffusion barrier and to prevent CuSn intermetallic formation in the apparatus (col. 6, lines 43-46), wherein the base metal layer further diffusion contacts the diffusion barrier layer to physically isolate the base metal layer and the bump.

Fig. 7 of Tong shows most aspect of the instant invention except "the diffusion barrier comprises a metal alloy comprising boron and phosphorous." Lee discloses that the diffusion barrier comprises a metal alloy comprising boron and phosphorous (paragraph [0035]).

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teachings of Lee into the device of Tong order to have the diffusion barrier comprising a metal alloy comprising boron and phosphorous to accommodate desired specification.

Regarding claim 10, it is obvious that the diffusion barrier layer of Tung's device is configured to suppress whisker-type formation in the bump layer since the material for the diffusion barrier layer of Tung's device is identical to the one in the instant invention.

Claims 4 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tong and Lee as applied to claim 1 above, and further in view of Hongo et al. (US Pub. 2002/017790), hereinafter Hongo.

Regarding claims 4 and 11, the combined teachings of Tong and Lee show that the base layer metal comprises a Ti adhesion layer (320; col. 2, lines 58-61), however, fail to show a seed layer comprising Co. Hongo discloses a seed layer comprising Co (paragraph [0049]).

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teachings of Hongo into the device of Tong in order to have a seed layer comprised of Co to improve the adhesion of the conductive layer to the substrate.

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sambucetti and Lee further in view of Tong.

Regarding claim 6, the combined teachings of Sambucetti and Lee show most aspect of the the instant invention except "wherein the bump layer comprises a Sn alloy, the Sn alloy comprising one of 0.7Cu, Bi and Sb, wherein the bump layer being electroplated is further configured to prevent low temperature phase transition of Sn from alpha Sn into beta Sn" Fig. 7 of Tong shows that the bump layer comprises a Sn alloy, the Sn alloy comprising one of 0.7Cu,

Bi, Sb, and Sb, wherein the bump layer being electroplated is further configured to prevent low temperature phase transition of Sn from alpha Sn into beta Sn (col. 4, lines 54-59),

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teachings of Tong into the device of Sambucetti in order to have the bump layer comprising an alloy, the alloy comprising one of 0.7Cu, Bi, and Sb, wherein the Sn bump layer being electroplated is further configured to prevent low temperature phase transition of Sn from alpha Sn into beta Sn to strengthen the connection of the solder bump to the package.

It is noted that it is well known in the art that the transformation of alpha Sn into beta Sn at low temperature.

Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tong and Lee as applied to claim 9 above, and further in view of Sambucetti.

Regarding claim 14, the combined teachings of Tong and Lee show most aspect of the instant invention except that the wetting layer comprises one of CoB and NiP. Sambucetti discloses that the wetting layer comprises one of CoB and NiP. (col. 6, lines 1-30).

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teachings of Sambucetti into the device of Tong and Lee in order to have the wetting layer comprising one of CoB and NiP to improve adherence.

Claims 32 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tong and Lee further in view of Kazama et al. (US 6639315), hereinafter Kazama.

Regarding claim 32, Fig. 7 of Tong shows an apparatus, comprising:

a semiconductor substrate (310);

a first conducting layer (316, 320) in contact with the semiconductor substrate, the first conducting layer comprising a base layer metal, the base layer metal comprising Cu (col. 6, line 4);

a diffusion barrier (330) in contact with the first conducting layer;

a wetting layer (340) on top of the diffusion barrier; and

a bump layer (370) on top of the wetting layer, the bump layer comprising Sn, the Sn bump layer, the diffusion barrier being configured to prevent Cu and Sn from diffusing through the diffusion barrier and to prevent CuSn intermetallic formation in the die packing interconnection (col. 6, lines 43-46).

Tong shows most aspect of the instant invention except "the diffusion barrier comprises a metal alloy comprising boron and phosphorous." Lee discloses that the diffusion barrier comprises a metal alloy comprising boron and phosphorous (paragraph [0035]).

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teachings of Lee into the device of Tong order to have the diffusion barrier comprising a metal alloy comprising boron and phosphorous to accommodate desired specification.

The combined teachings of Tong and Lee show the most aspect of the instant invention except "one or more components comprising circuitry; and one and more layers on the circuit board to route at least one signal between components on the circuit board, wherein at least one of the components on the circuit board comprises a die packaging interconnect." Fig. 5 of Kazama shows a circuit board (10) with a circuit for routing the signal.

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teachings of Kazama into the device of Tong and Lee in order to have a circuit board soldered to the interconnection of the semiconductor device to make a complete package.

Regarding claim 33, Kazama discloses a memory system on the circuit board (col. 15, line 18).

Response to Arguments

Applicant's arguments with respect to pending claims have been considered but are moot in view of the new ground(s) of rejection.

Allowable Subject Matter

Claims 5 and 12 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Junghwa M. Im whose telephone number is (571) 272-1655. The examiner can normally be reached on MON.-FRI. 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C. Lee can be reached on (571) 272-1732. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

jmi

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